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CLINICAL ARTICLE

Obstetrics

Psychological distress during pregnancy and adverse maternal and perinatal health outcomes: The role of socioeconomic status

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Abstract

Objective: To study the contribution of socioeconomic status (SES) to the prevalence of psychological distress during pregnancy, and to investigate the association between psychological distress and maternal and perinatal health among different SES groups.

Methods: This study was embedded in the Generation R study. Multiple self-reported questionnaires were used to measure psychological distress. Prevalence differences between SES groups were tested with the χ^2 test. Linear and logistic regression analyses were used to examine the associations between psychological distress and maternal and perinatal health outcomes.

Results: Women of low SES experience symptoms of psychopathology distress 4.5 times as often and symptoms of stress 2.5 times as often as women with of high SES. Women of low SES experiencing symptoms of psychopathology are at greater risk of delivering preterm. We also found associations between psychological distress and adverse perinatal health outcomes among women of middle and high SES.

Conclusion: The present study shows that the associations between SES, psychological distress, and maternal and perinatal health are complex, but do exist. To provide a better understanding of these associations, it is important to include mental health information in the standard national data collection on pregnant women, as this allows population-based studies.

KEYWORDS
perinatal health, pregnancy, psychological disorders, psychopathology, socioeconomic status, stress, maternal health

1 | INTRODUCTION

Over one-third of pregnant women experience psychological distress, defined as a state of emotional suffering characterized by symptoms of depression, general stress, and/or anxiety.[1] Such mental health problems during pregnancy have been adversely associated with maternal and perinatal health.[2,3]

A major risk factor for psychological distress is having a low socioeconomic status (SES). Individuals with a low SES are 1.5–3.5 times more likely to experience symptoms of psychopathology compared with

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individuals with a higher SES.[4,5] SES is also a known determinant of maternal and perinatal health, with lower SES being associated with higher risks of adverse maternal and perinatal health outcomes.[6,7] Having a low SES may amplify the known negative impact of psychological distress on maternal and perinatal health. The reserve capacity model supports this hypothesis.[8] This model is based on the idea that individuals with a low SES have fewer psychosocial and psychological resources to manage psychological distress compared to individuals with a higher SES.[8] Additionally, their psychosocial and psychological resources are further reduced by prolonged and/or repeated stress exposures.[8]

To promote a healthy and equal start for the unborn, and therewith lifetime health, it is important to investigate the impact of psychological distress, as well as the role of SES during pregnancy. We hypothesized that women with a low SES experiencing psychological distress have a higher risk of developing adverse maternal and perinatal health outcomes compared to women with a higher SES. Therefore, using data from a large urban population of pregnant women in the city of Rotterdam (the Netherlands), we aimed to investigate the contribution of SES to the prevalence of different dimensions of psychological distress. Educational level was used as a proxy for SES, as it reflects particular aspects of someone's SES and it helps to determine occupational and income opportunities, which in turn influence health. Secondly, we studied the association between psychological distress and maternal and perinatal health outcomes among different SES groups.

2 | MATERIALS AND METHODS

2.1 | Design and study population

The research methods follow the CONSORT guidelines. The present study was embedded in the Generation R Study, an ongoing population-based cohort study, studying pregnant women and their children from fetal life onwards.[9] The Medical Ethical Committee (MEC 198.782/2001/31) approved the study and all participants gave written informed consent. Between April 2002 and January 2006, 9778 participants living in the study area (Rotterdam, the Netherlands) were enrolled. For our study, only women who were included during pregnancy ($n=8879$, 91%) and gave birth to a live-born singleton baby ($n=8678$, 89%) were eligible.

2.2 | Exposure variables

Psychopathology and stress as dimensions of psychological distress were measured with multiple self-reported questionnaires administered during the second and third trimesters of pregnancy.

Maternal psychopathology

Psychopathology was measured with the Brief Symptom Inventory (BSI), a validated 53-item questionnaire that assesses nine dimensions of psychopathology in the preceding 7 days.[10,11] The total score of all subscales, referred to as the Global Severity Index (GSI), was calculated as an indicator of overall psychopathology. Additionally, separate scores for the nine BSI subscales were calculated.

Maternal stress

The Social Readjustment Rating Scale (SRRS) was used to identify major stressful life events in the preceding 12 months.[12] Each item has a certain amount of life change units (LCUs), depending on the severity. We used the Long Lasting Difficulties Questionnaire (LLDQ), a 12-item tool, to measure long-term difficulties regarding finances, social relationships, housing, and work.[13] The 12-item "general functioning" subscale of the Family Assessment Device (FAD) was used to measure family functioning, including problem-solving, communication, and affective responsiveness.[14] The 13-item Pregnancy Outcome Questionnaire (POQ) was used to evaluate maternal stress and anxiety regarding the baby's and mother's health, childbirth, and parenting.[15] All questionnaires were translated into Dutch and for every questionnaire average scores were calculated by dividing the sum of all items by the number of items.

2.3 | Socioeconomic status

We chose the highest completed educational level as a proxy for maternal SES because educational level not only reflects particular aspects of someone's SES, but it also, at the same time, helps to determine occupational and income opportunities, which in turn influence health. Educational level was self-reported at enrolment. Following the definition of Statistics Netherlands, we divided SES into three categories: (1) low (i.e., no education, primary education, lower vocational training, intermediate general school or 3 years or less of general secondary school); (2) middle (i.e., more than 3 years of general secondary school, intermediate vocational training or first year of higher vocational training); and (3) high (i.e., higher vocational training, university, and PhD degree).[16]

2.4 | Covariates

All potential confounding factors in our dataset have been investigated on the basis of a literature study. Based on the findings of this literature search, ethnicity and mode of conception were included in our analyses as potential confounders. Ethnicity was assessed by country of birth of the pregnant woman and her parents and classified into three categories based on the definition of Statistics Netherlands[17]: (1) Dutch, (2) non-Dutch/western, and (3) non-Dutch/non-western. We dichotomized mode of conception in spontaneous and non-spontaneous conception (i.e., fertility treatment to conceive). Missing values for ethnicity and mode of conception were 0.1% and 4.7%, respectively. Up to 5% missing information was

considered low and therefore no additional measures were taken to account for missing values.

2.5 | Outcomes

The primary outcome was the prevalence of psychological distress (i.e., psychopathology or stress) during pregnancy, stratified by SES. We defined clinically relevant symptoms of psychopathology as having a GSI score ≥0.71, and for the subscales as: (1) somatization score ≥0.57, (2) obsessive-compulsive score ≥0.96, (3) interpersonal sensitivity score ≥0.95, (4) depression score ≥0.80, (5) anxiety score ≥0.71, (6) hostility score ≥0.55, (7) phobic anxiety score ≥0.49, (8) paranoid ideation score ≥0.69, and (9) psychoticism score ≥0.62.[18] We defined clinically relevant symptoms of stress as: (1) a SRRS score ≥150,[19] or (2) a LLDQ score ≥0.5, or (3) a FAD score >2.17, or (4) a POQ score ≥1.25.

Secondary outcomes that we studied were: (1) preterm birth (PTB), (2) small for gestational age (SGA), (4) gestational age measured in weeks of gestation, (5) fetal growth restriction, (6) pregnancy-induced hypertension, (7) preeclampsia, and (8) assisted delivery (i.e., assisted vaginal delivery and/or cesarean section).

2.6 | Statistical analyses

Descriptive data were compared to identify major differences between women with a different SES. We assessed the prevalence of psychological distress within the different SES groups and tested differences with a χ^2 test.

The associations between psychological distress and the secondary outcome measures were examined using both linear and logistic regression analyses. The analyses were first performed on the entire study population, before stratifying for SES. In order to reduce the number of predicting variables tested, we performed a principal component analysis (PCA) for psychopathology and stress separately. PCA is a data reduction method, used to summarize a set of possibly correlated variables into a set of linear uncorrelated variables called principal components (PCs), while retaining most of the variation in the dataset.[20] We performed the Kaiser–Meyer–Olkin (KMO) test, to check if our data were suitable for PCA. Subsequently, we performed the PCA and selected all PCs with an eigenvalue above one. Bivariate linear and logistic regression analyses were performed to study the associations between the PCs and the secondary outcome measures. Multivariable linear and logistic regression analyses were used to adjust for potential confounders.

If an association between the PC and one of the secondary outcome measures was statistically significant ($P<0.05$), additional linear and/or logistic regression analyses were performed to examine the associations between the individual psychopathology and stress measures and maternal and perinatal health outcomes. All statistical analyses were performed using Stata software (Stata SE 15.1; Stata Corporation, College Station, TX, USA).

3 | RESULTS

3.1 | Baseline characteristics

Of the 8678 women who were eligible for our study, we excluded 1169 participants (13%) with missing data in one of the exposure or outcome variables and 281 (4%) participants with hypertension prior to pregnancy (Figure 1). All baseline characteristics were compared between women of low, middle, and high SES. More than a quarter had a low SES ($n=1885$ [26.1%]). These low-SES women were more often multiparous (975 [51.7%] vs 913 [40.6%] and 1248 [40.1%]), single mothers (503 [27.1%] vs 368 [16.7%] and 134 [4.4%]), smokers (578 [32.0%] vs 407 [19.3%] and 235 [8.1%]), and more often had a non-western ethnicity (1158 [61.6%] vs 1047 [46.9%] and 474 [15.3%]) compared with women with a middle and high SES (Table 1).

3.2 | Socioeconomic status and psychological distress

Compared with women with a high SES, we found that low-SES women were 4.5 times more likely to experience psychopathology ($\chi^2(2)=216.52$, $P<0.01$) (Figure 2) and 2.5 times more likely to experience stress during pregnancy ($\chi^2(2)=389.86$, $P<0.01$) (Figure 3).

3.3 | Psychological distress and pregnancy outcomes

We selected one PC for psychopathology with component loadings between 0.29 and 0.36. This PC was negatively associated with birth weight ($\beta=-16$, 95% confidence interval [CI] −21 to −10, $P<0.01$) and gestational age ($\beta=-0.02$, 95% CI −0.03 to −0.00, $P=0.05$) and positively associated with PTB (odds ratio [OR] 1.06, 95% CI 1.02–1.11, $P<0.01$) and SGA (OR 1.04, 95% CI 1.01–1.08, $P=0.01$) among all pregnant women. After stratification for SES, the psychopathology PC showed a positive association with PTB (OR 1.06, 95% CI 1.00–1.13, P 0.04) among women with a low SES, both before and after adjustment for confounders (Table 2). Among women with a middle and high SES, the psychopathology PC was negatively associated with birth weight ($\beta=-14$, 95% CI −24 to −5, $P<0.01$ and $\beta=-14$, 95% CI −26 to −2, P 0.03) (Table 3). Additionally, among women with a high SES, the psychopathology PC was also positively associated with SGA (OR 1.08, 95% CI 1.01–1.16, $P=0.03$) and an assisted delivery (OR 1.09, 95% CI 1.04–1.15, $P<0.01$) (Tables 2 and 3; Table S1).

We also selected one PC for stress with component loadings between 0.46 and 0.57. This PC was negatively associated with birth weight ($\beta=-46$, 95% CI −57 to −30, $P<0.01$) and gestational age ($\beta=-0.07$, 95% CI −0.10 to −0.03, $P<0.01$) and positively associated with PTB (OR 1.11, 95% CI 1.02–1.22, $P=0.02$) and SGA (OR 1.16, 95% CI 1.09–1.23, $P<0.01$) among all pregnant women. After stratification for SES, the stress PC showed no association with any of the predefined secondary outcome measures among women with a low

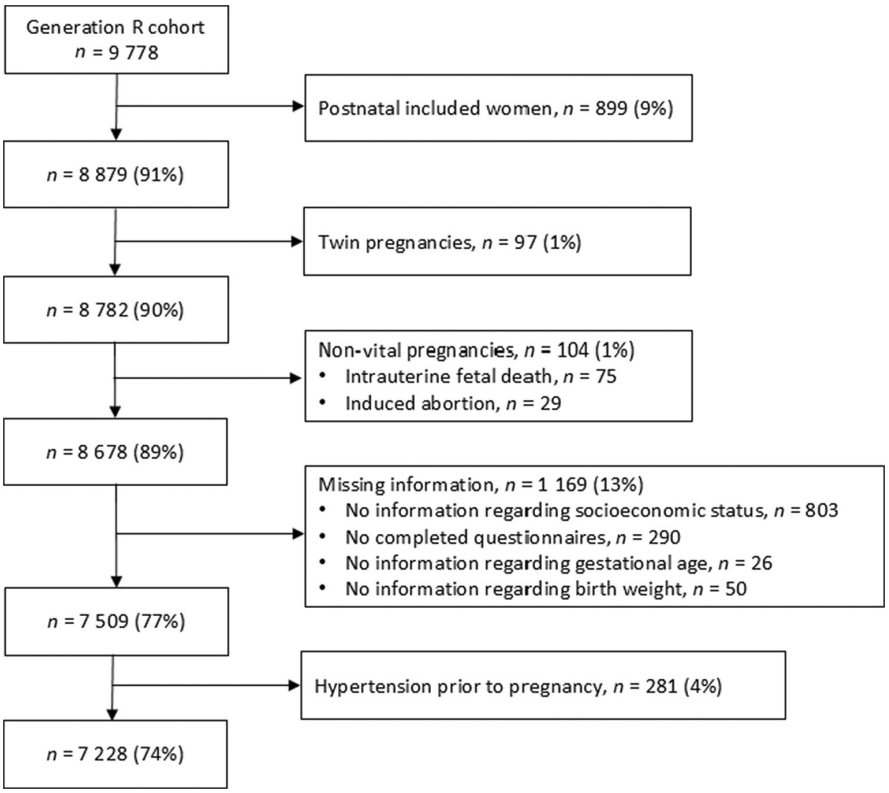

FIGURE 1 Flow chart of study sample.

SES (Tables 2 and 3; Table S1). For women with a middle and high SES, the stress PC showed a positive association with SGA (OR 1.12, 95% CI 101–1.25, $P=0.03$; and OR 1.27, 95% CI 1.13–1.43, $P<0.01$) and a negative association with birth weight ($\beta=-32$, 95% CI −50 to −14, $P<0.01$; and $\beta=-52$, 95% CI −71 to −32, $P<0.01$) (Tables 2 and 3). Additionally, for women with a high SES, the stress PC was positively associated with PTB (OR 1.26, 95% CI 1.08–1.46, $P<0.01$), intrauterine growth restriction (OR 1.30, 95% CI 1.02–1.65, $P=0.03$), and an assisted delivery (OR 1.11, 95% CI 1.02–1.21, $P=0.02$), and negatively associated with gestational age ($\beta=-0.09$, 95% CI −0.15 to −0.08, $P<0.01$) (Tables 2 and 3; Table S1).

4 | DISCUSSION

Using data from over 7000 singleton pregnancies, we found that women with a low SES experience significantly more psychological distress than women with a middle or high SES. Additionally, we found that women with a low SES experiencing symptoms of psychopathology during pregnancy are at greater risk of delivering preterm. We also found associations between psychological distress and adverse perinatal health among women with a middle and high SES.

The literature is consistent with our findings, regarding the association between low SES and higher levels of psychological distress during pregnancy.[21,22] These women experience a double threat during pregnancy: an increased risk of experiencing symptoms of psychopathology and an increased likelihood of delivering preterm once they are suffering from psychopathology. A possible underlying pathway through which psychopathology leads to preterm birth is dysregulation of the hypothalamic–pituitary–adrenocortical (HPA) axis. Psychopathology enhances the release of corticotropin-releasing hormone (CRH) and cortisol in the maternal circulation. During pregnancy, CRH is also expressed in the placenta and membranes. Cortisol in the maternal circulation stimulates rather than inhibits the production of CRH in the placenta. Low levels of placental CRH prevent the onset of labor. However, once a threshold is reached, CRH plays a significant role in the preparation for the initiation of labor.[23] Additionally, high maternal cortisol levels could modulate systemic and local immune responses, increasing the susceptibility to intrauterine and fetal infection/inflammatory processes, enhancing the risk of preterm delivery.[24]

Additionally, enhanced cortisol levels in the maternal circulation due to dysregulation of the HPA axis might reduce uteroplacental blood flow by stimulating vasoconstriction, enhancing the risk of hypertensive disorders of pregnancy.[2,25,26] However, in contrast to this hypothesis, we did not find any associations between psychological distress and pregnancy-induced hypertension or pre-eclampsia. A possible explanation for this are the low rates of hypertensive disorders of pregnancy (preeclampsia, 1.6%; pregnancy-induced hypertension, 1.9%) in the present study sample compared with the Dutch prevalence rates of hypertensive disorder of pregnancy during the study period (8.3%).[27]

Lastly, we also found associations between psychological distress and perinatal health outcomes for women with a middle and high SES. These findings highlight the importance of avoiding stress

TABLE 1 Baseline characteristics.

	Socioeconomic status			
	Total	Low	Mid	High
	N = 7228	*N* = 1885	*N* = 2234	*N* = 3109
Maternal characteristics				
Maternal age (y) (mean [SD])	29.9 (5.2)	27.3 (5.8)	28.7 (5.1)	32.3 (3.8)
Nulliparous (%)	4092 (56.7%)	910 (48.3%)	1321 (59.4%)	1861 (59.9%)
Pre-pregnancy BMI (median [IQR])	22.7 (20.8–25.5)	23.7 (21.1–27.2)	23.0 (21.0–26.0)	22.1 (20.6–24.2)
Spontaneous conception (%)	6788 (98.6%)	1739 (98.8%)	2108 (98.8%)	2941 (98.4%)
Spontaneous delivery (%)	5119 (78.0%)	1342 (78.5%)	1561 (77.1%)	2216 (78.2%)
Ethnicity (%)				
Dutch	3682 (51.0%)	607 (32.3%)	932 (41.8%)	2143 (69.0%)
Non-Dutch/western	858 (11.9%)	115 (6.1%)	253 (11.3%)	490 (15.8%)
Non-Dutch/non-western	2679 (37.1%)	1158 (61.6%)	1047 (46.9%)	474 (15.3%)
Marital status (%)				
Married/living together	6109 (85.9%)	1352 (72.9%)	1839 (83.3%)	2918 (95.6%)
No partner	1005 (14.1%)	503 (27.1%)	368 (16.7%)	134 (4.4%)
Smoking habits (%)				
Never smoked during pregnancy	5020 (73.6%)	1088 (60.2%)	1513 (71.8%)	2419 (83.4%)
Smoked until pregnancy was known	577 (8.5%)	141 (7.8%)	188 (8.9%)	248 (8.5%)
Continued smoking in pregnancy	1220 (17.9%)	578 (32.0%)	407 (19.3%)	235 (8.1%)
Maternal complications during pregnancy				
Pregnancy induced hypertension (%)	131 (1.9%)	29 (1.6%)	49 (2.2%)	53 (1.7%)
Pre-eclampsia (%)	108 (1.6%)	38 (2.1%)	39 (1.8%)	31 (1.0%)
Maternal psychopathology and stress during pregnancy				
Psychopathology (BSI, %)	620 (10.4%)	272 (19.0%)	237 (13.1%)	111 (4.1%)
Social stress (SRRS, %)	571 (9.5%)	238 (16.6%)	203 (11.2%)	130 (4.7%)
Long-lasting stress (LLDQ, %)	1009 (16.7%)	379 (26.2%)	373 (20.3%)	257 (9.3%)
Family functioning (FAD, %)	560 (9.5%)	221 (16.1%)	207 (11.7%)	132 (4.8%)
Pregnancy related stress (POQ, %)	1022 (15.3%)	421 (24.6%)	378 (18.3%)	223 (7.7%)
Child characteristics				
Intrauterine growth restriction (%)	109 (1.6%)	30 (1.7%)	40 (1.9%)	39 (1.3%)
Gestational age (wk) (mean [SD])	39.9 (1.7)	39.7 (1.8)	39.8 (1.7)	40.1 (1.6)
Birth weight (g) (mean [SD])	3429.2 (551.4)	3338.2 (552.2)	3389.8 (552.6)	3512.6 (538.1)
Preterm birth (%)	337 (4.7%)	115 (6.1%)	99 (4.4%)	123 (4.0%)
Small for gestational age (%)	666 (9.2%)	208 (11.0%)	233 (10.4%)	225 (7.2%)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); BSI, Brief Symptom Inventory; FAD, family assessment device; IQR, interquartile range; LLDQ, Long Lasting Difficulties Questionnaire; POQ, Pregnancy Outcome Questionnaire; SD, standard deviation; SRRS, Social Readjustment Rating Scale.

among all pregnant women. We have not been able to find other studies that support this association. Research is needed to understand if and how pregnant women with a middle and high SES experiencing psychological distress have an increased risk of adverse maternal and perinatal health outcomes.

The main strengths of this study lie in its population-based prospective design and the large number of participants with a follow-up from early pregnancy onwards. Detailed information on different dimensions of psychological distress, as well as different measurements on maternal and perinatal health, and confounding factors were available. Next to these strengths, several limitations merit discussion. First, women included in the Generation R study were more highly educated (43% in this study vs 32% in the general population of Rotterdam) and somewhat healthier (i.e., experience lower rates of medical complications) than expected based on figures from the city of Rotterdam, the area from which participants were recruited.[28] This is a common phenomenon in health research. The underrepresentation of women with a low SES in our study population may have led to a loss of power to estimate an effect of psychological distress on adverse maternal and perinatal health outcomes among women with

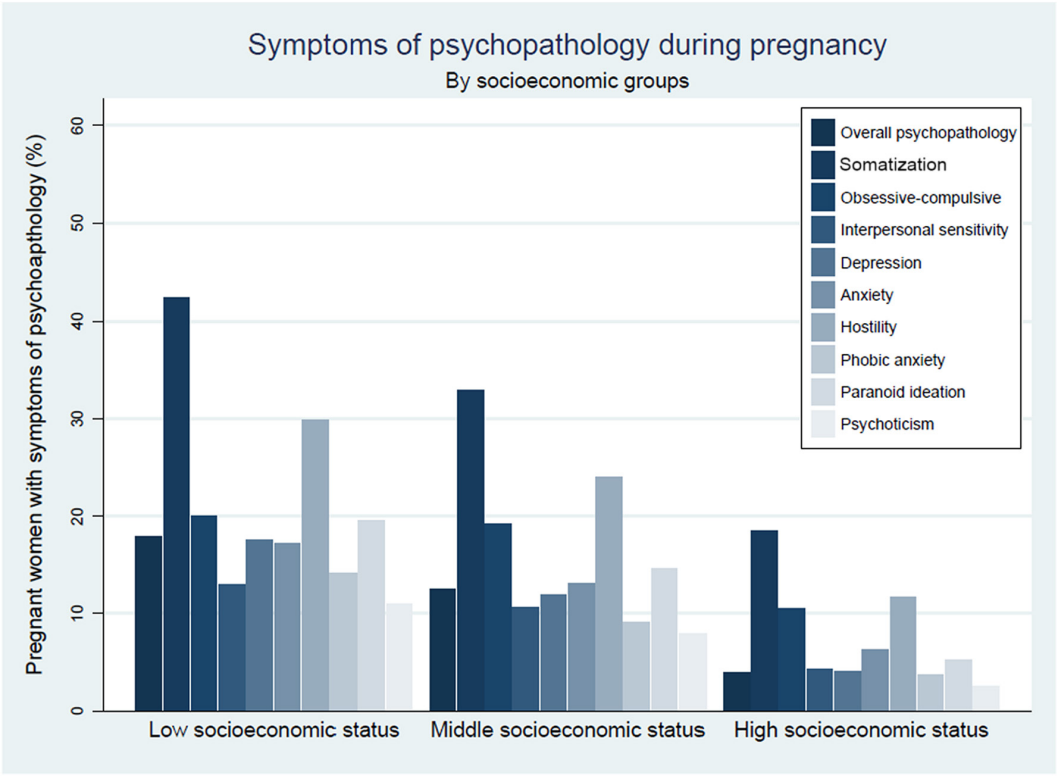

FIGURE 2 Percentage of pregnant women with symptoms of psychopathology during pregnancy stratified by socioeconomic status.

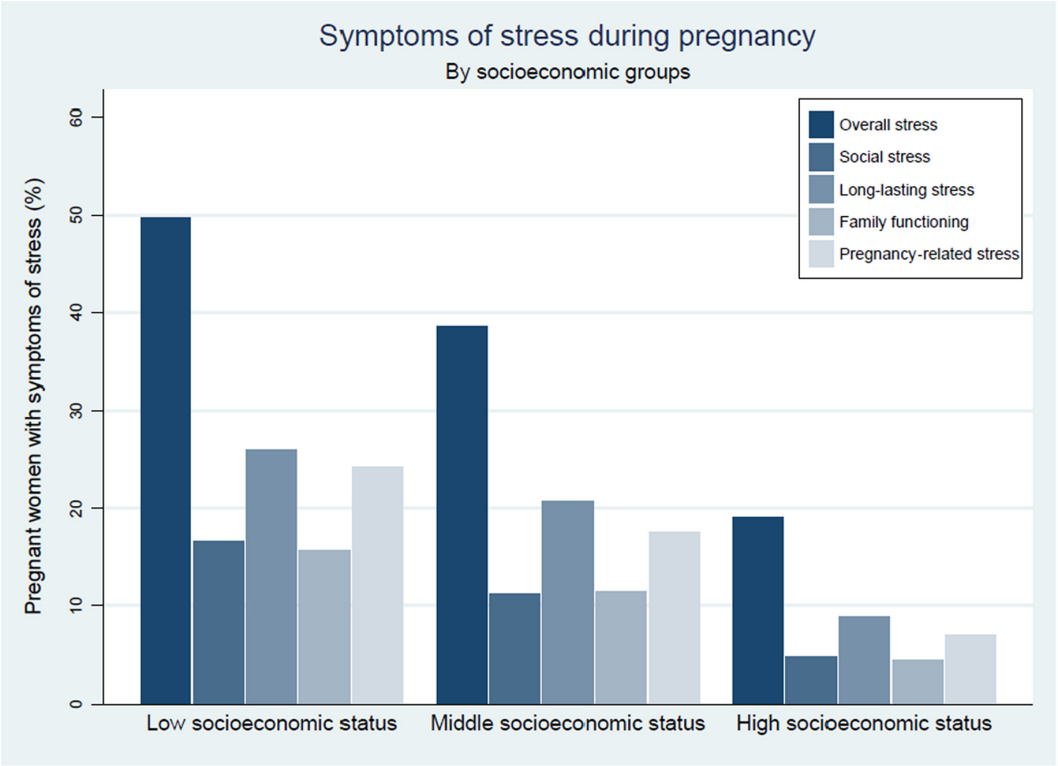

FIGURE 3 Percentage of pregnant women with symptoms of stress during pregnancy stratified by socioeconomic status.

a low SES. Second, we used a single indicator of education as a proxy for SES. The most frequently used individual level determinants of SES are educational level, income, employment status, and wealth.[29] However, of these, educational level is the most suitable determinant to use as a proxy for SES among young adults (up to the age of 40 years) as shown by Galobardes et al.[30] An additional advantage

TABLE 2 Logistic regression analyses of psychopathology and stress and preterm birth and small for gestational age.

	Low socioeconomic status				Mid socioeconomic status				High socioeconomic status			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Preterm birth												
Principal component—psychopathology[b]	1.06 (1.00–1.13)	0.04	1.07 (1.01–1.14)	0.03	1.02 (0.94–1.11)	0.56	1.02 (0.94–1.11)	0.59	1.06 (0.96–1.17)	0.23	1.08 (0.97–1.20)	0.14
Overall, BSI	1.57 (1.07–2.31)	0.02	1.60 (1.08–2.39)	0.02	na	na	na	na	na	na	na	na
Somatization	1.41 (1.00–1.98)	0.05	1.43 (1.00–2.05)	0.05	na	na	na	na	na	na	na	na
Obsessive-compulsive	1.55 (1.15–2.08)	<0.01	1.54 (1.14–2.10)	0.01	na	na	na	na	na	na	na	na
Interpersonal sensitivity	1.40 (1.04–1.90)	0.03	1.43 (1.05–1.94)	0.02	na	na	na	na	na	na	na	na
Depression	1.39 (1.04–1.85)	0.03	1.40 (1.04–1.89)	0.03	na	na	na	na	na	na	na	na
Anxiety	1.23 (0.88–1.73)	0.22	1.26 (0.89–1.78)	0.19	na	na	na	na	na	na	na	na
Hostility	1.50 (1.07–2.11)	0.02	1.48 (1.05–2.09)	0.03	na	na	na	na	na	na	na	na
Phobic anxiety	1.21 (0.79–1.85)	0.39	1.25 (0.81–1.92)	0.31	na	na	na	na	na	na	na	na
Paranoid ideation	1.39 (1.05–1.84)	0.02	1.42 (1.06–1.89)	0.02	na	na	na	na	na	na	na	na
Psychoticism	1.45 (0.98–2.15)	0.07	1.46 (0.97–2.19)	0.07	na	na	na	na	na	na	na	na
Principal component –stress[b]	1.01 (0.86–1.19)	0.91	1.03 (0.87–1.22)	0.71	1.01 (0.85–1.21)	0.90	0.1.01 (0.83–1.23)	0.91	1.26 (1.08–1.46)	<0.01	1.33 (1.12–1.58)	<0.01
Social stress, SRRS[c]	na	na	na	na	na	na	na	na	1.68 (0.80 – 3.54)	0.17	1.89 (0.88–4.05)	0.10
Long-lasting stress, LLDQ	na	na	na	na	na	na	na	na	2.17 (1.11–4.23)	0.02	2.72 (1.31–5.65)	0.01
Family functioning, FAD	na	na	na	na	na	na	na	na	1.48 (0.97–2.25)	0.07	1.37 (0.88–2.15)	0.17
Pregnancy stress, POQ	na	na	na	na	na	na	na	na	2.30 (1.38–2.83)	<0.01	2.52 (1.45–4.37)	<0.01
Small for gestational age												
Principal component—psychopathology[b]	0.99 (0.94–1.04)	0.67	0.98 (0.92–1.04)	0.47	1.03 (0.98–1.09)	0.21	1.02 (0.96–1.08)	0.50	1.08 (1.01–1.16)	0.03	1.00 (0.92–1.09)	0.94
Overall, BSI	na	na	na	na	na	na	na	na	1.81 (1.15–2.85)	0.01	1.10 (0.64–1.89)	0.74
Somatisation	na	na	na	na	na	na	na	na	1.27 (0.85–1.88)	0.24	0.89 (0.58–1.38)	0.61
Obsessive-compulsive	na	na	na	na	na	na	na	na	1.11 (0.80–1.53)	0.53	0.91 (0.64–1.27)	0.57
Interpersonal sensitivity	na	na	na	na	na	na	na	na	1.44 (1.04–2.00)	0.03	1.16 (0.81–1.67)	0.43
Depression	na	na	na	na	na	na	na	na	1.70 (1.24–2.34)	<0.01	1.23 (0.84–1.79)	0.30
Anxiety	na	na	na	na	na	na	na	na	1.60 (1.14–2.25)	0.01	1.18 (0.80–1.76)	0.41
Hostility	na	na	na	na	na	na	na	na	1.51 (1.03–2.20)	0.03	1.08 (0.69–1.68)	0.73
Phobic anxiety	na	na	na	na	na	na	na	na	1.20 (0.64–2.22)	0.57	0.56 (0.24–1.31)	0.18

(Continues)

TABLE 2 (Continued)

	Low socioeconomic status				Mid socioeconomic status				High socioeconomic status			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*	OR (95% CI)	*P*
Paranoid ideation	na	na	na	na	na	na	na	na	1.43 (1.01–2.03)	0.05	0.99 (0.65–1.49)	0.96
Psychoticism	na	na	na	na	na	na	na	na	1.72 (1.10–2.68)	0.02	1.25 (0.76–2.04)	0.38
Principal component—stress[b]	1.00 (0.89–1.14)	0.95	0.95 (0.83–1.09)	0.49	1.12 (1.01–1.25)	0.03	1.06 (0.94–1.19)	0.34	1.27 (1.13–1.43)	<0.01	1.11 (0.97–1.27)	0.11
Social stress, SRRS[c]	na	na	na	na	1.38 (0.89–2.14)	0.15	1.26 (0.81–1.98)	0.31	1.69 (0.95–3.00)	0.07	1.20 (0.64–2.26)	0.57
Long-lasting stress, LLDQ	na	na	na	na	1.26 (0.81–1.95)	0.30	1.06 (0.66–1.69)	0.82	2.12 (1.27–3.56)	<0.01	1.30 (0.73–2.32)	0.37
Family functioning, FAD	na	na	na	na	1.28 (0.95–1.73)	0.11	1.13 (0.83–1.56)	0.43	1.66 (1.22–2.28)	<0.01	1.37 (0.98–1.93)	0.07
Pregnancy stress, POQ	na	na	na	na	1.21 (0.84–1.75)	0.31	1.03 (0.70–1.52)	0.88	2.07 (1.41–3.05)	<0.01	1.50 (0.99–2.26)	0.06

Abbreviations: BSI, Brief Symptom Inventory; CI, confidence interval; FAD, Family Assessment Device; GSI, Global Severity Index; LLDQ, Long Lasting Difficulties Questionnaire; na, not applicable; OR, odds ratio; POQ, Pregnancy Outcome Questionnaire; SRRS, Social Readjustment Rating Scale.

[a]Adjusted for ethnicity and mode of conception.

[b]If the association between the principal component and preterm birth and/or small for gestational age was statistically significant ($P < 0.05$), additional linear regression and/or logistic regression analyses were performed to examine the associations between the individual psychopathology and stress measures and preterm birth and/or small for gestational age.

[c]The predictor social stress is dichotomized in social stress yes/no; all others are continuous predictors.

TABLE 3 Linear regression analyses of psychopathology and stress and birth weight and gestational age.

	Low socioeconomic status						Middle socioeconomic status						High socioeconomic status					
	Unadjusted			Adjusted[a]			Unadjusted			Adjusted[a]			Unadjusted			Adjusted[a]		
	$\bar{x}$	β (95% CI)	*P*	$\bar{x}$	β (95% CI)	*P*	$\bar{x}$	β (95% CI)	*P*	$\bar{x}$	β (95% CI)	*P*	$\bar{x}$	β (95% CI)	*P*	$\bar{x}$	β (95% CI)	*P*
Birth weight																		
Principal component—psychopathology[b]	3355	−2 (−12 to 7)	0.63	3359	−3 (−12 to 7)	0.60	3408	−14 (−24 to −5)	<0.01	3489	−7 (−17 to 3)	0.17	3513	−14 (−26 to −2)	0.03	3554	−3 (−16 to 9)	0.60
Overall, BSI	na	na	na	na	na	na	3434	−95 (−157 to −33)	<0.01	3497	−43 (−108 to 23)	0.21	3537	−101 (−180 to −21)	0.01	3559	−27 (−112 to 6)	0.54
Somatization	na	na	na	na	na	na	3435	−73 (−122 to −23)	<0.01	3495	−24 (−77 to 29)	0.38	3530	−47 (−106 to 12)	0.12	3553	8 (−55 to 70)	0.81
Obsessive-compulsive	na	na	na	na	na	na	3415	−18 (−62 to 26)	0.42	3492	−2 (−47 to 44)	0.94	3533	−29 (−75 to 17)	0.22	3560	−7 (−54 to 40)	0.77
Interpersonal sensitivity	na	na	na	na	na	na	3416	−49 (−97 to −0)	0.05	3489	−23 (−73 to 28)	0.38	3521	−24 (−80 to 32)	0.40	3554	9 (−49 to 66)	0.77
Depression	na	na	na	na	na	na	3421	−71 (−118 to −24)	<0.01	3494	−38 (−88 to 12)	0.14	3531	−102 (−163 to −40)	<0.01	3.560	−52 (−117 to 14)	0.12
Anxiety	na	na	na	na	na	na	3430	−89 (−140 to −37)	<0.01	3501	−59 (−113 to −4)	0.03	3535	−85 (−143 to −26)	0.01	3.563	−49 (−110 to 12)	0.12
Hostility	na	na	na	na	na	na	3424	−66 (−120 to −12)	0.02	3496	−35 (−91 to 22)	0.23	3521	−13 (−76 to 50)	0.68	3.549	36 (−31 to 10)	0.29
Phobic anxiety	na	na	na	na	na	na	3414	−100 (−168 to −31)	<0.01	3491	−42 (−115 to 30)	0.26	3526	−107 (−200 to −14)	0.02	3.557	−40 (−138 to 6)	0.42
Paranoid ideation	na	na	na	na	na	na	3420	−62 (−107 to −17)	0.01	3493	−30 (−77 to 17)	0.21	3528	−77 (−138 to −17)	0.01	3558	−27 (−91 to 38)	0.42
Psychoticism	na	na	na	na	na	na	3414	−74 (−139 to −8)	0.03	3490	−29 (−97 to 40)	0.42	3526	−88 (−171 to −5)	0.04	3557	−32 (−116 to 53)	0.47
Principal component—stress[b]	3368	−16 (−37 to 5)	0.13	3365	−16 (−38 to 6)	0.15	3420	−32 (−50 to −14)	<0.01	3487	−12 (−32 to 8)	0.22	3493	−52 (−71 to −32)	<0.01	3537	−33 (−54 to −12)	<0.01
Social stress, SRRS[c]	na	na	na	na	na	na	3417	−89 (−168 to −10)	0.03	3493	−56 (−137 to 24)	0.17	3523	−111 (−205 to −16)	0.02	3557	−67 (−164 to 3)	0.18
Long-lasting stress, LLDQ	na	na	na	na	na	na	3411	−42 (−119 to 35)	0.29	3478	22 (−60 to 104)	0.60	3547	−180 (−265 to −93)	<0.01	3571	−120 (−211 to −29)	0.01
Family functioning, FAD	na	na	na	na	na	na	3510	−69 (−121 to −18)	0.01	3521	−27 (−81 to 27)	0.33	3611	−65 (−114 to −17)	0.01	3599	−32 (−82 to 18)	0.21
Pregnancy stress, POQ	na	na	na	na	na	na	3481	−94 (−155 to −32)	<0.01	3496	−36 (−102 to 29)	0.28	3649	−177 (−235 to −120)	<0.01	3.655	−136 (−196 to −76)	<0.01
Gestational age																		
Principal component—psychopathology[b]	39.77	−0.00 (−0.03 to 0.03)	0.92	39.75	−0.01 (−0.04 to 0.02)	0.63	39.89	−0.02 (−0.04 to 0.01)	0.28	39.97	−0.01 (−0.04 to 0.02)	0.66	40.09	0.01 (−0.03 to 0.04)	0.78	40.14	0.01 (−0.03 to 0.05)	0.53
Principal component—stress[b]	39.75	−0.00 (−0.07 to 0.07)	0.98	39.71	−0.02 (−0.10 to 0.05)	0.60	39.90	−0.02 (−0.08 to 0.03)	0.42	39.96	−0.00 (−0.06 to 0.06)	0.93	40.04	−0.09 (−0.15 to −0.03)	<0.01	40.07	−0.08 (−0.15 to −0.02)	0.01
Social stress, SRRS[c]	na	na	na	na	na	na	na	na	na	na	na	na	40.09	−0.20 (−0.48 to 0.09)	0.18	40.12	−0.19 (−0.49 to 0.10)	0.20
Long-lasting stress, LLDQ	na	na	na	na	na	na	na	na	na	na	na	na	40.15	−0.41 (−0.67 to −0.16)	<0.01	40.18	−0.43 (−0.70 to −0.15)	<0.01
Family functioning, FAD	na	na	na	na	na	na	na	na	na	na	na	na	40.28	−0.14 (−0.29 to 0.01)	0.06	40.27	−0.11 (−0.26 to 0.05)	0.17
Pregnancy stress, POQ	na	na	na	na	na	na	na	na	na	na	na	na	40.26	−0.24 (−0.41 to −0.06)	0.01	40.27	−0.20 (−0.38 to −0.02)	0.03

Abbreviations: BSI, Brief Symptom Inventory; CI, confidence interval; FAD, Family Assessment Device; GSI, Global Severity Index; LLDQ, Long Lasting Difficulties Questionnaire; na, not applicable; OR, odds ratio; POQ, Pregnancy Outcome Questionnaire; SRRS, Social Readjustment Rating Scale.

[a]Adjusted for ethnicity and mode of conception.

[b]If the association between the principal component and preterm birth and/or small for gestational age was statistically significant ($P < 0.05$), additional linear regression and/or logistic regression analyses were performed to examine the associations between the individual psychopathology and stress measures and preterm birth and/or small for gestational age.

[c]The predictor social stress is dichotomized in social stress yes/no; all others are continuous predictors.

of using educational level as a proxy for SES compared with income level, employment status, and wealth is that educational level reflects a broad range of other non-economic resources, such as health-related knowledge, literacy, and problem-solving skills, which may influence health. Therefore, for the current study, we decided to use educational level only as a proxy for SES. A third limitation is that we relied on self-reported symptoms of psychological distress, instead of diagnostic interviews. However, this disadvantage is minimized, as the questionnaires are used as screening devices rather than diagnostic tools. We did not aim to diagnose psychological distress but wanted to investigate how perceived symptoms of psychological distress affect maternal and perinatal health outcomes. Fourth, as in any cohort study, we might have lacked information on measured and unmeasured confounding factors. Before investigating potential confounding factors, we made a directed acyclic graph (DAG) to map a priori assumptions surrounding the causal question(s) of interest. All factors available in the Generation R dataset were included in this DAG. The generation R dataset is a large dataset containing information on numerous maternal and perinatal characteristics. Based on the assumptions found, we performed a literature search to determine which determinants should be included in our analyses as confounding factors. However, despite this, we might have lacked information on measured and unmeasured factors which may have affected the association.

The present study adds to an emerging body of evidence that suggest that psychological distress during pregnancy negatively affects the mother-to-be and her child, regardless the SES of the pregnant women. Pregnancy offers a window of opportunity to universally screen women for psychological distress. Future research should clarify which resources are needed by pregnant women with psychological distress to cope with their situation. These insights can contribute to the development of care pathways for parents(–to-be) who are in need of additional guidance and support.

5 | CONCLUSION

The present study shows that the associations between SES, psychological distress, and maternal and perinatal health are complex, but do exist. In order to provide a better understanding of these associations in the future, it is important to include information regarding mental health in the standard national data collection on pregnant women, as this allows population-based studies.

AUTHOR CONTRIBUTIONS

All authors have made significant contributions to this scientific work and approved the final version of the manuscript. LAD was involved in the conception and design of the study, performed the data analyses, and wrote the manuscript. JL was involved in the conception and design of the study, supervised the data analyses, and co-wrote the manuscript. EAPS was involved in the conception and design of the study, reviewed the manuscript, and provided extensive feedback. HEM was involved in the conception and design of the study, reviewed the manuscript, and provided extensive feedback. AGP was involved in the conception and design of the study, reviewed the manuscript, and provided extensive feedback.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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